

The process standards of **problem solving, reasoning and proof, connections communication, and representation** are interwoven and independent with the content standards and are necessary for the comprehensive understanding of mathematics.

Strand: **M1 Numbers and Operations**

Pre-Kindergarten through Grade 12 instructional programs should enable all students to:

- understand numbers, ways of representing numbers, relationships among numbers and number systems;
- understand meanings of operations and how they relate to one another;
- understand how to compute fluently and make reasonable estimates.

In Grade 5, all students should:

- Standards:
- M1a:** understand place value and explain the relationship to addition and subtraction and multiplication and division of decimals;
  - M1b:** identify and generate equivalent forms of fractions, decimals, and percents;
  - M1c:** explain how decimals and percents are parts of a whole;
  - M1d:** use models to develop the concept of ratio as part to part and part to whole;
  - M1e:** represent and compare numbers less than zero by extending the number line and using familiar applications, like temperature, to demonstrate the usefulness of negative numbers;
  - M1f:** identify and use the distributive properties to simplify and/or perform computations;
  - M1g:** use order of operations, including the use of parentheses, to simplify numerical expressions;
  - M1h:** explain why fractions need common denominators to be added or subtracted;
  - M1i:** understand the concept of multiplication and division of fractions;
  - M1j:** understand and compute positive integer powers of nonnegative integers as repeated multiplication;
  - M1k:** demonstrate proficiency with two-digit divisors;
  - M1l:** use models and equivalent forms to add and subtract fractions with like and unlike denominators expressing answers in simplest form;
  - M1m:** estimate the results of computations involving whole numbers, fractions, and decimals, using a variety of strategies;
  - M1n:** compute and perform simple multiplication and division of fractions and decimals.

Essential To Know: Students apply the appropriate order of operations for expressions involving addition, subtraction, multiplication, and division. Students use, interpret, and construct multiple representations of a number and translate among equivalent relationships for integers, fractions, decimals, and percents.

Strand: **M2 Algebra**

Pre-Kindergarten through Grade 12 instructional programs should enable all students to:

- understand patterns, relations, and functions;
- represent and analyze mathematical situations and structures using algebraic symbols;
- use mathematical models to represent and understand quantitative relationships;
- analyze change in various contexts.

In Grade 5, all students should:

- Standards:
- M2a:** express a general rule for a pattern or a function by using visual representations, words, tables, or graphs;
  - M2b:** explain the concept of variable;
  - M2c:** use variables as unknown quantities in general rules when describing mathematical patterns and relationships;
  - M2d:** apply algebraic order of operations and the commutative, associative and distributive properties to algebraic expressions, equations, and inequalities;
  - M2e:** construct tables and graphs that accurately represent the relationship between two variables;
  - M2f:** identify, describe, and compare situations that represent constant or varying rates of change.

Essential To Know: Students use symbolic algebra to represent and explain mathematical relationships.

Strand: **M3 Geometry**

Pre-Kindergarten through Grade 12 instructional programs should enable all students to:

- analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships;
- specify locations and describe spatial relationships using coordinate geometry and other representational systems;
- apply transformations and use symmetry to analyze mathematical situations;
- uses visualization, spatial reasoning, and geometric modeling to solve problems.

In Grade 5, all students should:

- Standards:
- M3a:** identify faces, edges, vertices and bases of three-dimensional shapes;
  - M3b:** identify and plot ordered pairs in the first quadrant of a coordinate system;
  - M3c:** explore patterns that result from a combination of reflections, rotations, and translations of geometric figures, including rotational symmetry;
  - M3d:** visualize and draw two-dimensional views of three-dimensional objects made from rectangular solids.

Essential To Know: Students compare and analyze attributes and other features of two- and three-dimensional geometric shapes.

Strand: **M4 Measurement**

Pre-Kindergarten through Grade 12 instructional programs should enable all students to:

- understand measurable attributes of objects and the units, systems, and processes of measurement;
- apply appropriate techniques, tools, and formulas to determine measurements.

In Grade 5, all students should:

- Standards:
- M4a:** extend the recognition of measurable attributes to include volume (cubic units);
  - M4b:** convert standard units of measurement within both customary and metric systems of measurement, e.g., inches to feet, centimeters to meters, etc.;
  - M4c:** develop strategies for estimating the volume of various shapes;
  - M4d:** extend the use of appropriate standard tools and units to include measures of volume and angle size;
  - M4e:** develop strategies to determine the surface areas and volumes of rectangular solids;
  - M4f:** differentiate between units of measurement for two- and three-dimensional objects and use appropriately.

Essential To Know: Students use appropriate units of measurement to measure two- and three-dimensional objects.

Strand: **M5 Data Analysis and Probability**

Pre-Kindergarten through Grade 12 instructional programs should enable all students to:

- formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them;
- select and use appropriate statistical methods to analyze data;
- develop and evaluate inferences and predictions that are based on data;
- understand and apply basic concepts of probability.

In Grade 5, all students should:

- Standards:
- M5a:** explain and conduct sampling techniques for gathering data;
  - M5b:** select and use a graph that is appropriate for the type of data to be displayed;
  - M5c:** read and interpret quantitative and qualitative data;
  - M5d:** investigate the role of the mean as a balance point for the data set;
  - M5e:** recognize samples as subsets of larger populations;
  - M5f:** use a sample to make projections for a larger population;
  - M5g:** use common fractions to represent the probability of events that are neither certain nor impossible;
  - M5h:** compare theoretical and experimental outcomes in a simple experiment;
  - M5i:** make predictions based on experimental and theoretical probabilities.

Essential To Know: Students project information for a larger population based on a sample. Students explain the relationship between experimental and theoretical probabilities.

Strand: **M6 Problem Solving**

- Standard: **M6a:** Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to:
- build new mathematical knowledge through problem solving;
  - solve problems that arise in mathematics and in other contexts;
  - apply and adapt a variety of appropriate strategies to solve problems;
  - monitor and reflect on the process of mathematical problem solving.

Strand: **M7 Reasoning and Proof**

- Standard: **M7a:** Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to:
- recognize reasoning and proof as fundamental aspects of mathematics;
  - make and investigate mathematical conjectures;
  - develop and evaluate mathematical arguments and proofs;
  - select and use various types of reasoning and methods of proof.

Strand: **M8 Communication**

- Standard: **M8a:** Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to:
- organize and consolidate their mathematical thinking through communication;
  - communicate their mathematical thinking coherently and clearly to peers, teachers, and others;
  - analyze and evaluate the mathematical thinking and strategies of others;
  - use the language of mathematics to express mathematical ideas precisely.

Strand: **M9 Connections**

- Standard: **M9a:** Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to:
- recognize and use connections among mathematical ideas;
  - understand how mathematical ideas interconnect and build on one another to produce a coherent whole;
  - recognize and apply mathematics in contexts outside of mathematics.

Strand: **M10 Representation**

- Standard: **M10a:** Instructional programs from Pre-Kindergarten through Grade 12 should enable all students to:
- create and use representations to organize, record, and communicate mathematical ideas;
  - select, apply, and translate among mathematical representations to solve problems;
  - use representations to model and interpret physical, social, and mathematical phenomena.